# SPACELAB LIFE SCIENCES - 2 POST MISSION REPORT by Jay C. Buckey, Jr., M.D., Alternate Payload Specialist

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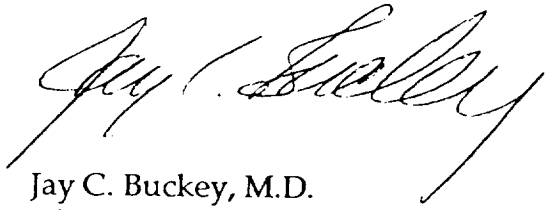
Final Report for Contract NAS 9-18736 "SLS-2 Payload Specialist Support" to the University of Texas-Southwestern Medical Center



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14 January 1994

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The SLS-2 mission achieved tremendous success both operationally and scientifically. The excellent leadership of Commander John Blaha, Payload Commander Rhea Seddon, and the Mission Management team made this success possible, and I would like to start my report by acknowledging the debt owed to them.

Commander Blaha formed a smoothly running team from a group of disparate individuals. He was respectful of all points of view and labored constantly to make the best decisions for the mission. He brought out the best in each team member, and he taught me volumes about management, working with people, and, most importantly, leadership. His approach to payload specialists should be the model for NASA to follow. He made every effort to insure that all the payload specialists on the flight, prime and alternate, knew that they were part of the crew and part of the team. He did this by following the guideline he set at the beginning of the project--treat everyone equally. If the rest of the crew had photos, launch invitations, etc. he made sure the payload specialists had these things as well. He supported me in my efforts to work with the Urine Monitoring System (UMS) and Body Mass Measurement Device (BMMD), projects that took considerable time and effort away from other activities.

Payload Commander Seddon worked tirelessly and successfully to balance the scientific needs of the experiments against hard operational realities. Her job was particularly challenging because the payload could easily fill all the time available on the mission. Her complete honesty and integrity won her the confidence of both the crew and the investigators, allowing her to arrange for a very productive but not exhausting timeline. She taught me to appreciate the constraints and difficulties inherent in on-orbit activities.

Mission Manager Lele Newkirk and Operations Manager Susan Brand deserve tremendous credit for their mastery of the innumerable details involved in this mission. Their support at critical times (e.g. bringing UMS syringes back from KSC, throughout the mission at Huntsville) allowed me to successfully complete my projects. They are extremely effective, capable managers, and the mission owes them a great debt.

## ACCOMPLISHMENTS SUMMARY

The team effort that was fostered allowed each crewmember to use his/her special talents and background to improve the mission. My background in engineering, medicine, and scientific research was very useful in several mission-related areas. In addition to training for the mission, validating procedures and communicating during the flight, I made contributions in the following areas:

1. Worked with the investigators, crew and Human Research Policy and Procedures Committee (HRPPC) representative M. Fettman, to reduce the isotope dosages administered to the crew.

2. Worked with Flight medicine to provide custom-made magnifying glasses for the crew to employ as needed.

3. Worked with the investigator teams and Life Science Project Division to identify and correct calibration problems with the Urine Monitoring System (UMS). This resulted in a completely new calibration procedure and new equipment that was used despite the very short time available for development. Numerous investigations were critically dependent on accurate data from the UMS.

4. Worked with the investigator teams and Life Science Project Division to test, modify and validate the Body Mass Measurement Device (BMMD) calibration procedure. This involved an end-to-end test of the unit at KSC in the Spacelab with the flight unit. Due to this effort the ground was able to have complete confidence during the mission that good data was being produced with the BMMD.

5. Encouraged instituting debriefs about communications with the Crew Interface Coordinators (CIC's), Alternate Payload Specialists (APS's) and crew immediately after simulations, and was supported by Commander Blaha. These sessions helped to identify problems in both the Payload Operations Control Center (POCC) and crew.

6. Encouraged reviews of data immediately following a simulation. These provided immediate feedback to the crew on how the simulation went.

7. Identified communication problems with the Science Monitoring Area. Solved the problem by requiring the investigator teams to communicate on the CIC loop. The investigators would give ongoing information about data quality, session progress and problems. This system was implemented during the flight and allowed for much more rapid communication with the crew about ongoing sessions.

8. Helped to bring an important U.S. investigation into the Bio-specimen sharing plan. Changes in procedures were tested and validated with the Ames Research Center (ARC) training team that proved the feasibility of incorporating tibial cartilage samples into the in-flight dissection. Dr. Jackie Duke was able to get specimens from SLS-2 because of this effort.

9. Helped in the writing and preparation of STS-58 Mission Highlights, the pamphlet that NASA will use to summarize and publicize the accomplishments on SLS-2.

## COMMENTS AND SUGGESTIONS

Although the mission was highly successful, in any project this size there are some items that could be improved or where a different perspective may be useful. This report will focus primarily on areas that need improvement. These comments should not cloud the main point, however, which is that the mission was a notable success.

### SELECTION

The payload specialist program began as a way for scientists and investigators to work on scientific projects in space. At the beginning of the Space Shuttle program, the use of payload specialists in space was considered by some to be the "central new feature of the Shuttle Space Transportation System" (Dr. Hans Mark, Former Deputy Director of NASA, 1977). Over time, the program has evolved to the point where many, if not most, payload specialists serve only a ground role. While the use of highly-trained scientists to serve as communicators for Shuttle missions may have some benefits to NASA, this is not what was intended when the payload specialist program began.

At the time of SLS-2 selection, many issues were not addressed about what the non-flying payload specialist(s) would do. As a result, the role of the alternate payload specialist was often unclear.

> Recommendation 1. Define the role of the alternate payload specialist. *Specify who the alternate would be backing up. Is the alternate there to backup all the individuals with intensive payload training or just selected individuals? For example, would a backup be used whenever a prime payload crewmember could not continue? Or would a substitute crewmember be recruited from the mission specialist office? The payload specialist candidates should know at the time of application who they would backup if they should become alternates.*

The payload specialist candidates underwent a ten month competitive period for one flying slot. When the candidates applied for the positions, there were two flying slots for payload specialists. One slot was filled from the astronaut office without any competition.

> Recommendation 2. Establish clear, objective guidelines for selecting payload specialists and limit the evaluation period to a more reasonable length. *If payload specialists are assigned from the astronaut office, they should compete with the other candidates and be evaluated by the same standards. In addition, if more than one alternate is chosen, the alternates should be ranked in advance according to who would be used first.*

Recommendation 3. The procedure of having the payload specialists selected and voted on by the investigators should be retained. *This system does work. The investigators should have the people they want working on the experiments.*

## TRAINING

Overall, the training was superb. All the trainers worked extremely hard to make sure the crew was up to date on changes and proficient on the major tasks. I have the following comments:

Recommendation 1. Establish a closer working relationship with the P.I. teams. *Visits to the P.I. laboratories were key and must be continued. The crew must understand the scientific reasons for the experiments and not just learn procedures. Frequent reviews of data products with the P.I. teams are essential. Whenever these took place, they were very worthwhile.*

Recommendation 2. Provide In Flight Maintenance (IFM) training to the APS's. *This was done on SLS-2 on Commander Blaha's suggestion and was very useful. The APS's became familiar with the format and procedures necessary for a successful IFM.*

Recommendation 3. Shorten POCC training. *The POCC training, while useful, depended heavily on lengthy classroom sessions. Fewer, intense, hands-on sessions would be more effective.*

Recommendation 4. Send the APS's to work in Mission Control. *This was also done on SLS-2 on the recommendation of Commander Blaha and Payload Commander Seddon and helped greatly. The interaction between the Flight Director and Capcom has many parallels to the POD, CIC relationship.*

Recommendation 5. Feedback from the P.I.s during training should be available. *This was always worthwhile.*

On SLS-1 some controversy developed about having payload specialists from an investigator's laboratory. In some quarters it was felt a payload specialist from a particular lab might show favoritism toward his/her experiment. Although I didn't agree with this criticism (after all, the investigators get to choose the payload specialists and know them well), I was concerned that criticism like this could be damaging to the payload specialist program. As a result, throughout SLS-2 I made every effort not to get involved in issues related to experiment 294 (Experiment- "Cardiovascular

Adaptation to Zero-Gravity" which I worked on for many years). Only later in the mission, when I was specifically asked, did I get involved in echo training and in some issues related to CVP measurements. In retrospect, I probably could have been helpful with a variety of experiment 294 issues, and future payload specialists should not feel so constrained. The mission management team should feel comfortable assigning payload specialists to work on issues related to their experiments.

Recommendation 6. Assign Payload Specialists to work on issues related to their experiments if their background and experience would be useful.

## SIMULATIONS

The simulations provided the best mission-like training. Different groups often had different opinions on what the goal of the simulation should be. The crew sometimes felt that the goal was to "exercise the POCC," and so they would not behave as they would in-flight. Instead of proposing solutions to problems they would wait for the POCC to resolve the problem. This often led to misunderstandings between the POCC and the crew, with the POCC wondering why the crew did not make a suggestion and the crew wondering why the POCC was taking so long. These misunderstandings often could lead to bad communication. Good communication between the POCC and the crew is absolutely critical to mission success. I suggested to Commander Blaha that we have a short debriefs about communications right after each simulation to talk honestly about problems. This was done and was useful.

Recommendation 1. Have a short debrief on communications with the crew, CIC and POD (and no one else) immediately after the simulation. *In this way, misunderstandings can be quickly resolved.*

The scientific data are the final product of the mission and the main reason for the flight. Since the debriefs were often two days after the simulation, the P.I. teams were not available for the debriefs, and their data were not reviewed. The data must be reviewed after each simulation. I, along with others, encouraged this. When it was done it gave the crewmembers immediate, useful feedback.

Recommendation 2. During each simulation the data should be evaluated in real time by the P.I. teams and debriefed with the crew immediately after the simulation. *The P.I. team often cannot stay in Houston for one or two more days to do a debrief*

*at a later time. Feedback on data quality has to be given in a small group with just the P.I. team, trainer and crew.*

**The two debriefs on communications and data should be the two top priorities immediately after a simulation.**

## MISSION OPERATIONS

The mission went smoothly and there were few major problems. One communication change that occurred late in the pre-flight period and carried through the flight was requiring the P.I. teams to report about their activities on the CIC loop. I had encouraged the P.I. teams to report major milestones on the CIC loop while their experiments were ongoing. This allowed for quick reports to the crew when things were going well and rapid responses when malfunctions developed. The use of the CIC loop to accomplish this worked well on SLS-2.

Recommendation 1. Train the P.I. teams to talk on the CIC loop. *The P.I. teams need to be more involved in simulations and should be required to make some calls about data quality and session completion.*

## BASELINE DATA COLLECTION

Although, by necessity, most of the preparation and training for the mission is devoted to the flight itself, from the scientific viewpoint the pre- and post-flight data are at least as important as the data from space. Considering the complexity of the arrangements, the data collection went very well. Although the data collection periods were long, they were well organized and necessary for the success of the mission.

Although as an alternate I did not have to participate as a subject in landing day (R+0) data collection, it should be noted that the problems with R+0 data collection (lengthy day, transportation problems) could have been alleviated if the crew had remained at the landing site for seven days as was done successfully on SLS-1 and had been repeatedly and consistently recommended by the investigators for nearly a decade.

The decision to have the alternates participate in data collection pre-flight was reasonable if the alternates did indeed serve as backups for all of the payload crewmembers. This, however, was never made clear.

## OBSERVATIONS

I was able to use my scientific and engineering backgrounds working on the UMS and BMMD. Both the Mission Management organization and the Life Science Project Division provided excellent support with the work necessary on these devices. These kind of projects are well suited to payload

specialists, who have the scientific background and interest in the experiments to work on them.

The payload specialists on the flight were underutilized in this regard. All of the payload specialists had long experience in scientific presentations and scientific work and could have applied this experience to SLS-2.

> Recommendation 1. Use the scientific background of the payload specialist. *Payload specialists should be encouraged to find areas where the scientific goals are not being met and to work on fixing the problems. Also, payload specialists often have experience in giving talks and presentations to scientific audiences. NASA should use this experience to reach skeptical groups.*

## CONCLUSIONS

SLS-2 was a very productive mission. Personally, I had the opportunity to learn about all the key details and complex arrangements that must take place to have a successful space mission. Scientifically, the data from both Spacelab Life Sciences-1 and Spacelab Life Sciences-2 are already radically changing our understanding of how humans adapt to spaceflight. This knowledge will be helpful, not only for planning longer and more challenging spaceflights, but also for understanding health problems here on Earth.

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ARC | Ames Research Center |
| APS | Alternate Payload Specialist |
| BMMD | Body Mass Measurement Device |
| CAPCOM | Capsule Communicators |
| CIC | Crew Interface Coordinators |
| CVP | Central Venous Pressure |
| HRPPC | Human Research Policy and Procedures Committee |
| IFM | In Flight Maintenance |
| KSC | Kennedy Space Center |
| PI | Principal Investigator |
| POCC | Payload Operations Control Center |
| POD | Payload Operations Director |
| PS | Payload Specialist |
| R+0 | Recovery plus 0 days, i.e. landing day |
| SLS-1 | Spacelab Life Sciences-1 |
| SLS-2 | Spacelab Life Sciences-2 |
| STS-58 | Space Transportation System Flight #58, a.k.a. SLS-2 |
| UMS | Urine Monitoring System |

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**16. Abstract**

Jay C. buckey, M.D., Assistant Professor of Medicine at The University of Texas Southwestern Medical Center at Dallas served as an alternate payload specialist astronaut for the Spacelab Life Sciences 2 Space Shuttle Mission from January 1992 through December 1993. This report summarizes his opinions on the mission and offers suggestions in the ares of selection, training, simulations, baseline data collection and mission operations. The report recognizes the contributions of the commander, payload commander and mission management team to the success of the mission. Dr. Buckey's main accomplishments during the mission are listed.

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